Analysis of event anisotropy and azimuthal pair correlation

--- looking for the origin of large v_2 at RHIC ---

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for the PHENIX collaboration
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v_2 w.r.t. R.P. vs correlation v_2
azimuthal correlation w.r.t. R.P.
- hadron-hadron correlation
- photon-hadron correlation

Quark Matter 2004
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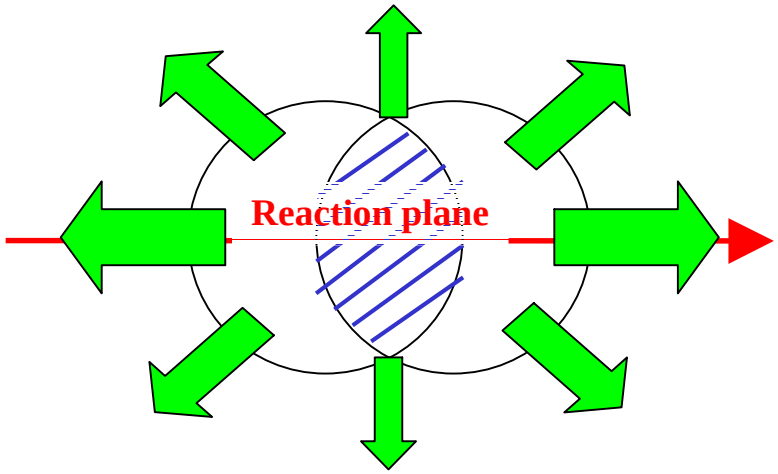
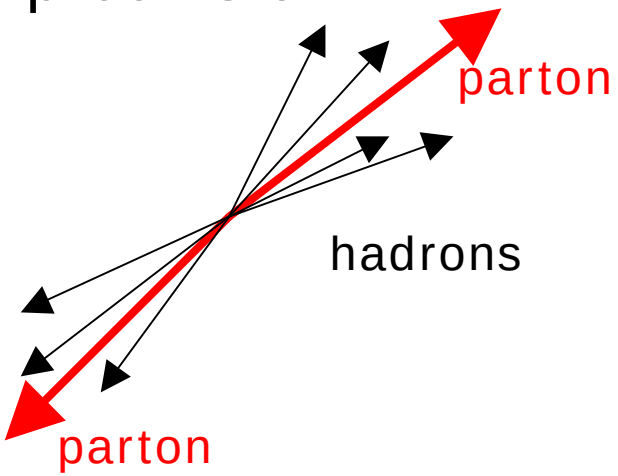
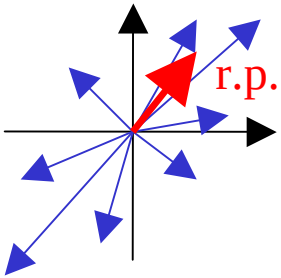
A+A collision



p+p collision

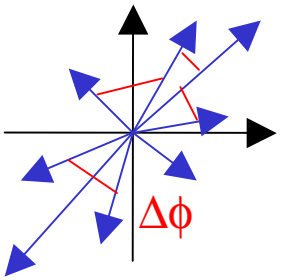




r.p. for a geometrical origin

suffer r.p. resolution (smeared shape)

$$dN/d(\phi-\Phi) = N\,(1 + \Sigma\, 2v_n{}'\cos(n(\phi-\Phi)))$$



no smearing (detailed shape analysis)

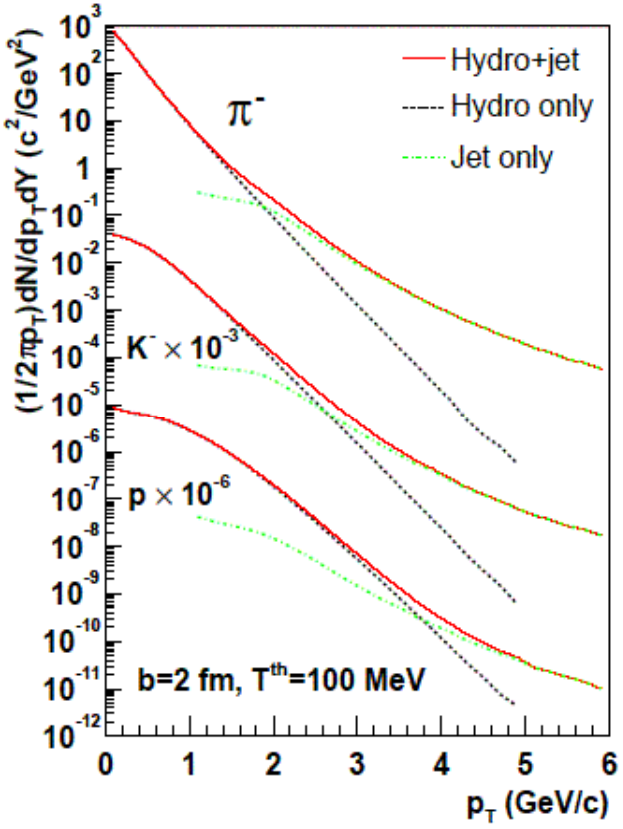
event anisotropy shape (no relation to r.p.)

$$N^{real}(\Delta\phi)/N^{mixed}(\Delta\phi) = N\,(1 + \Sigma\, 2v_n{}^2\cos(n(\Delta\phi)))$$

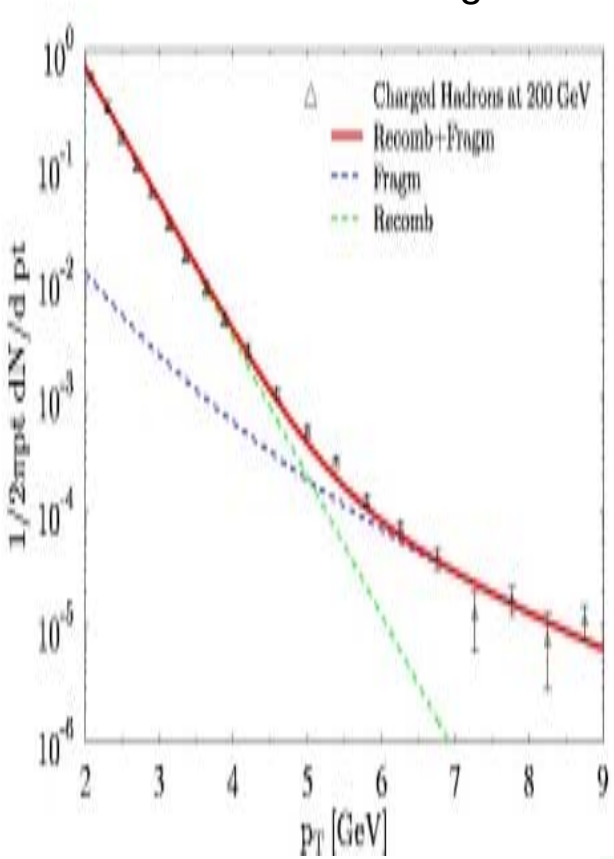
Models (hydro/recombination + jets/fragmentation)

(1) v_2 of soft hadrons
(2) amount of Jets
(3) v_2 of jets
(energy loss+
almond shape)

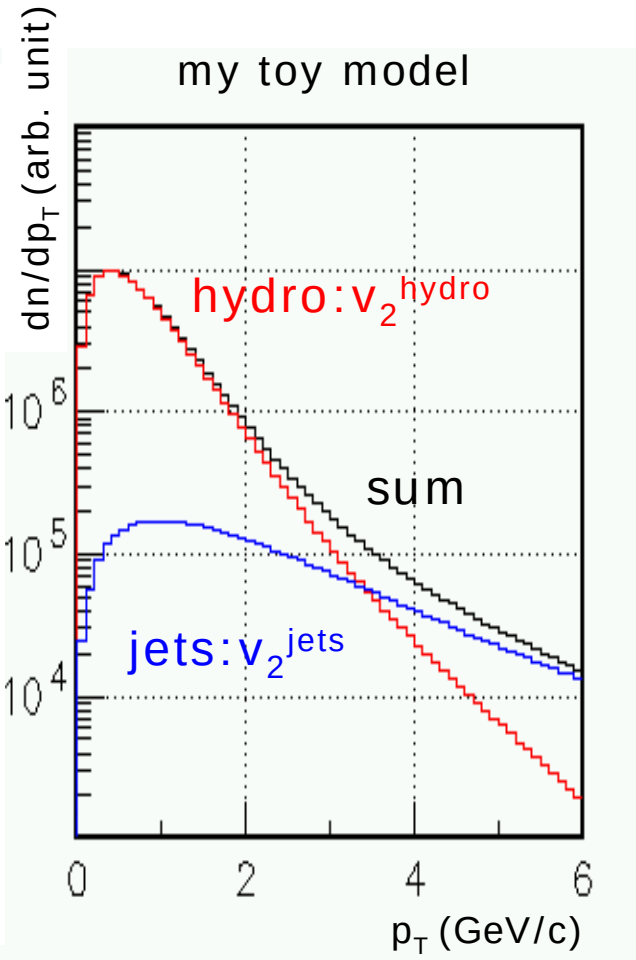
hydro+jets



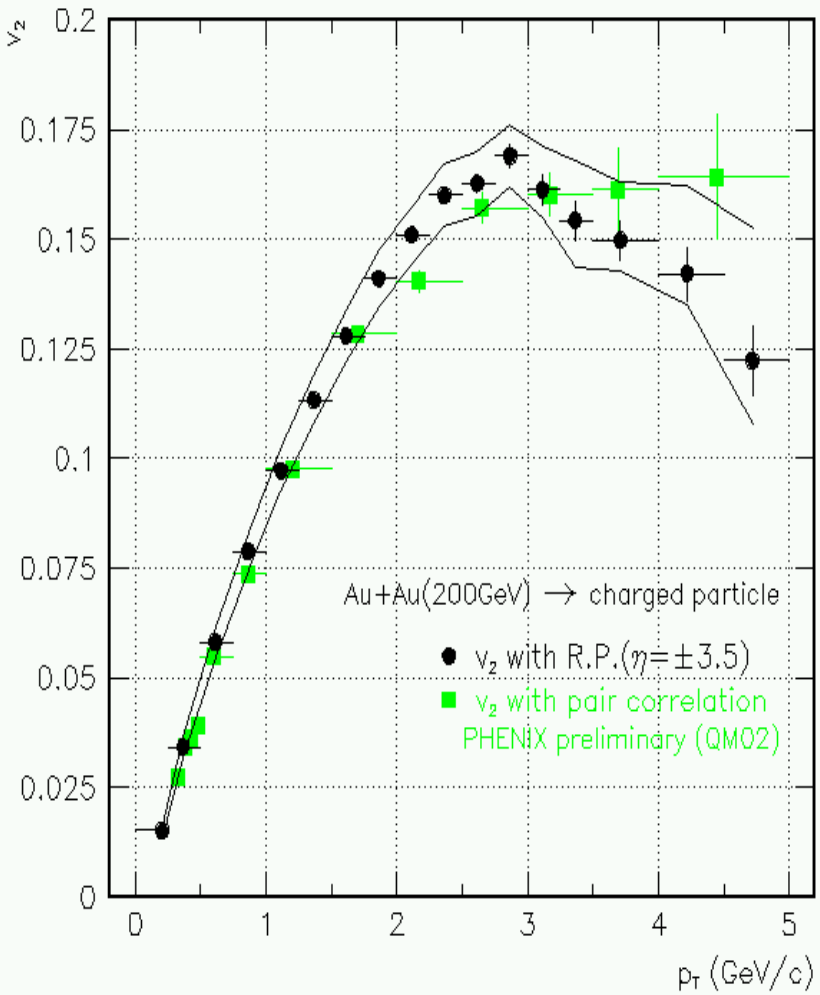
recomb.+fragm.



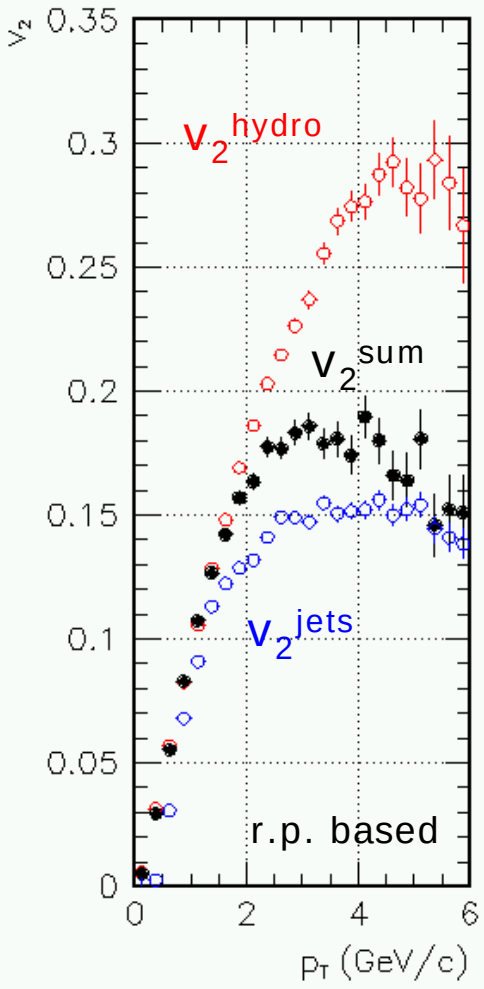
my toy model

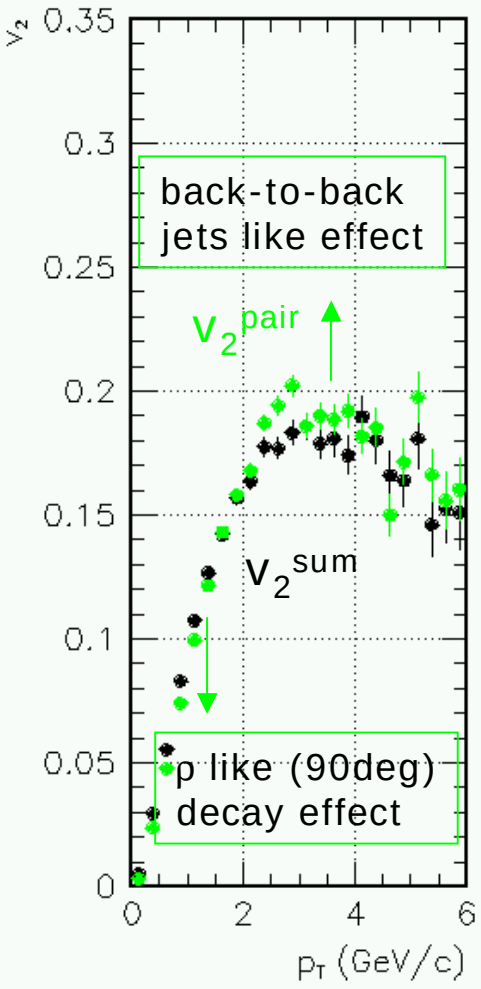


Au+Au 200GeV data

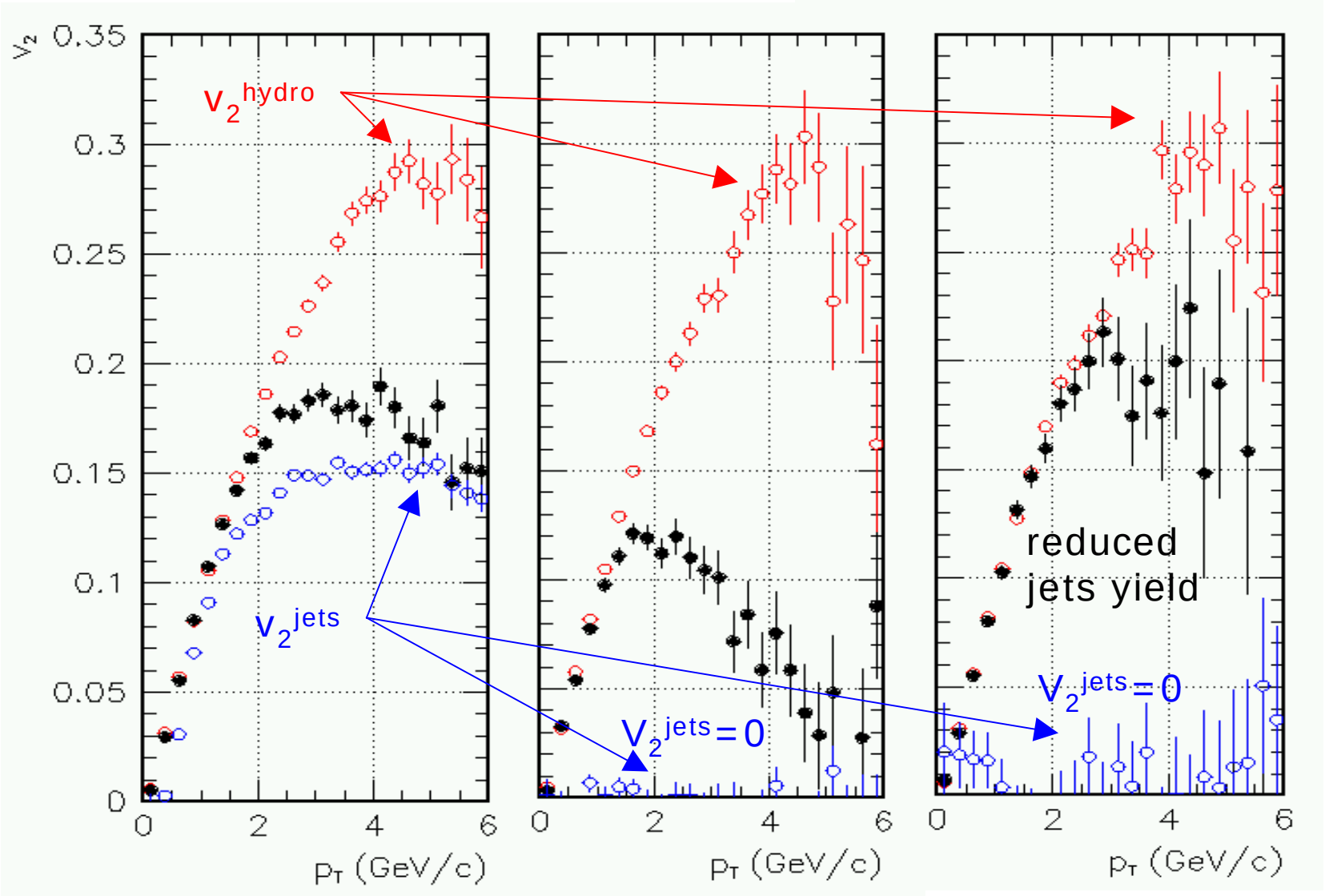


simulation

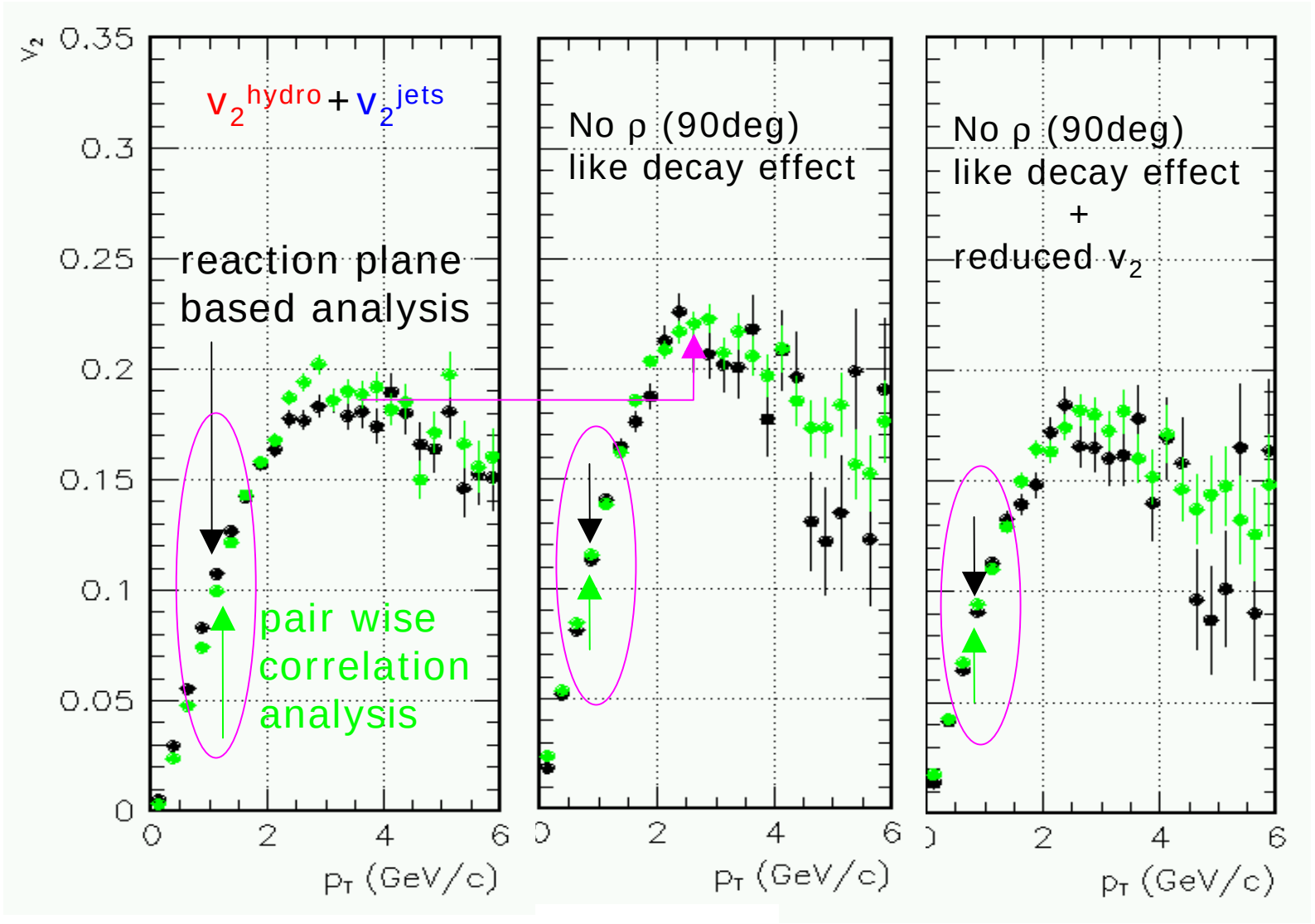




DNP03 / Fall

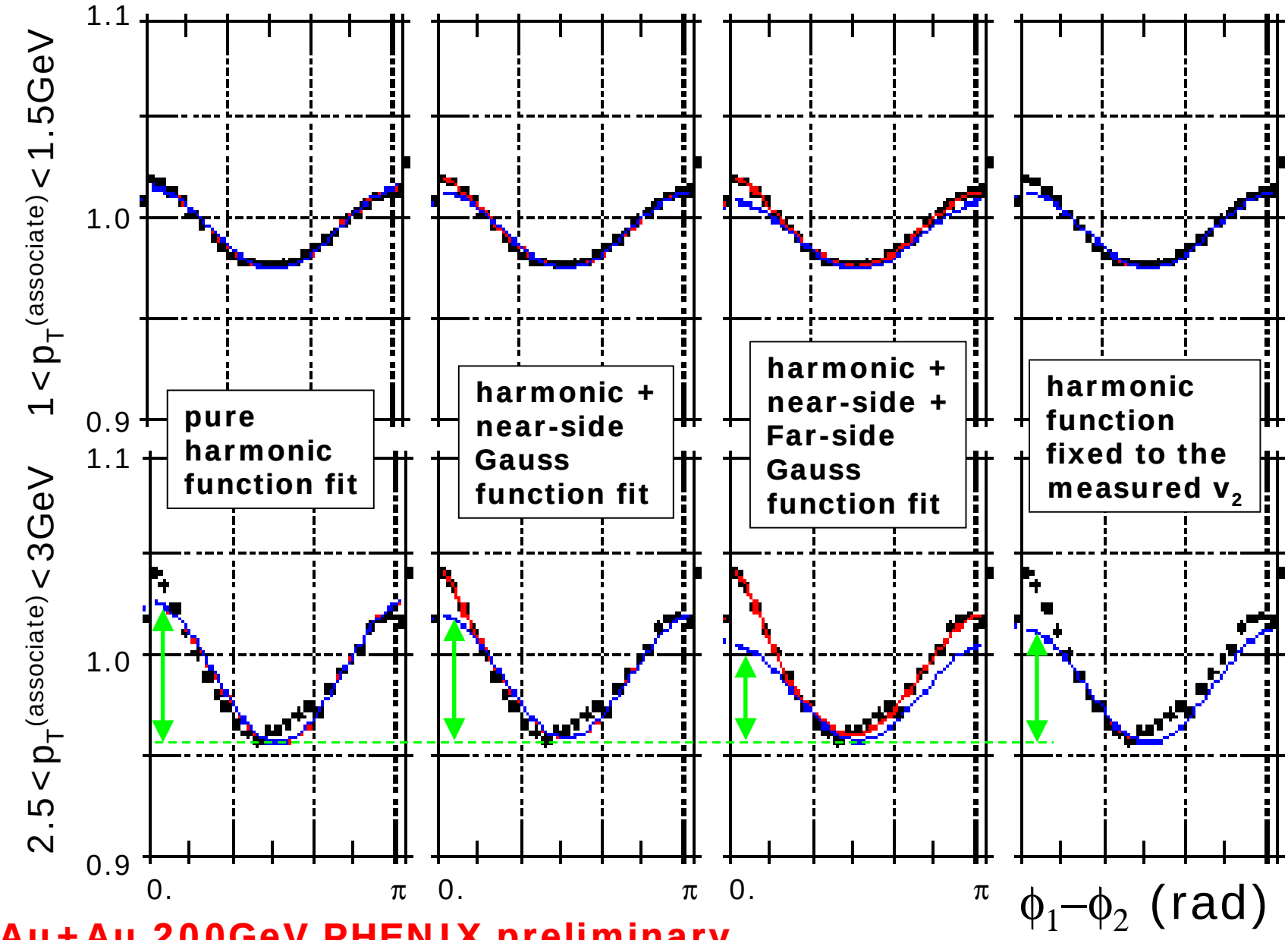

v_2
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
v_2^{hydro}
v_2^{jets}
$v_2^{jets}=0$
reduced
jets yield
$v_2^{jets}=0$
0
2
4
6
p_T (GeV/c)
p_T (GeV/c)
p_T (GeV/c)

simulation

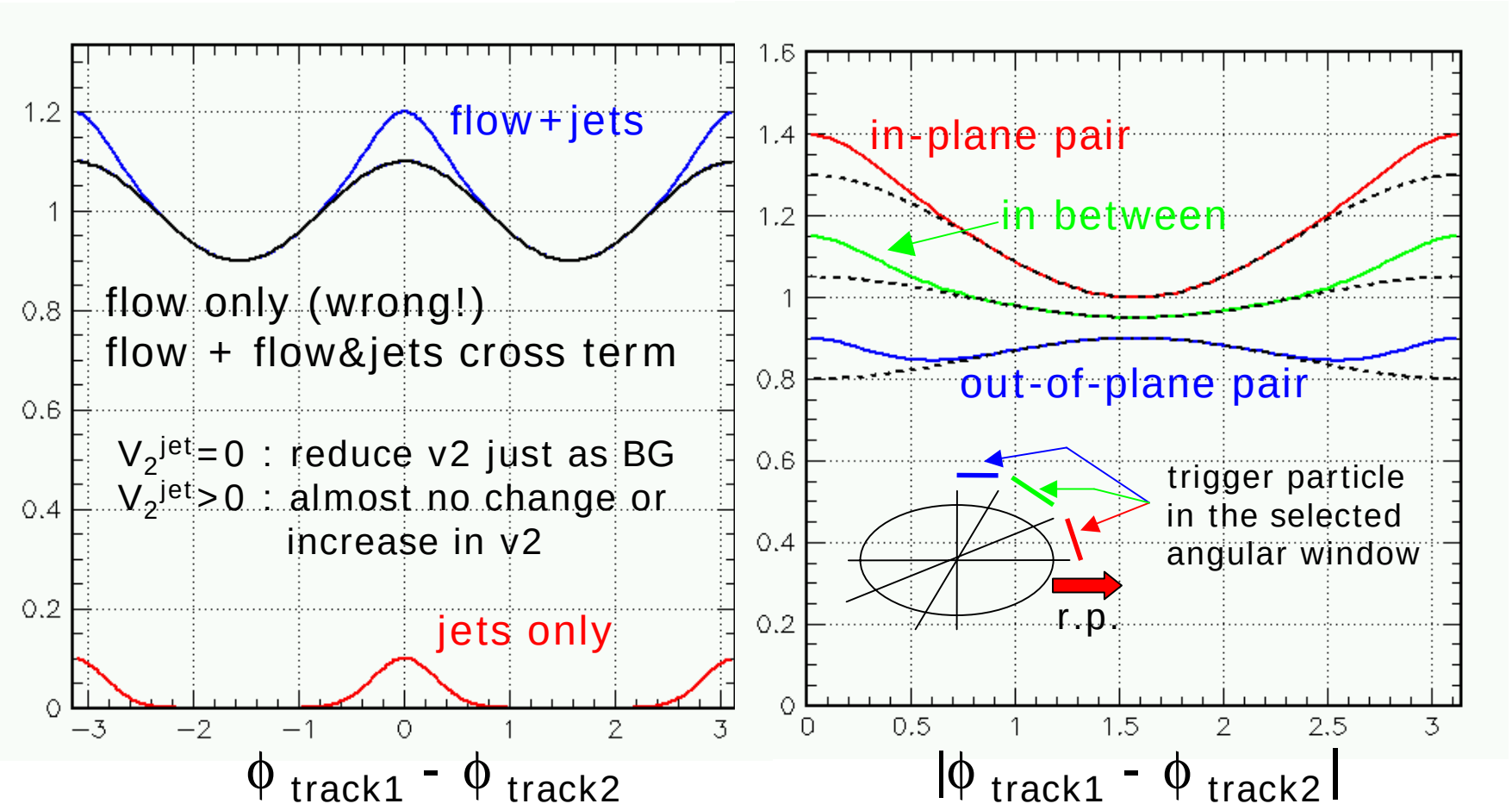

v_2
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
$v_2^{hydro} + v_2^{jets}$
reaction plane
based analysis
pair wise
correlation
analysis
No ρ (90deg)
like decay effect
No ρ (90deg)
like decay effect
+
reduced v_2
0
2
4
6
p_T (GeV/c)

simulation

hadron-hadron correlation (full p_T reference)

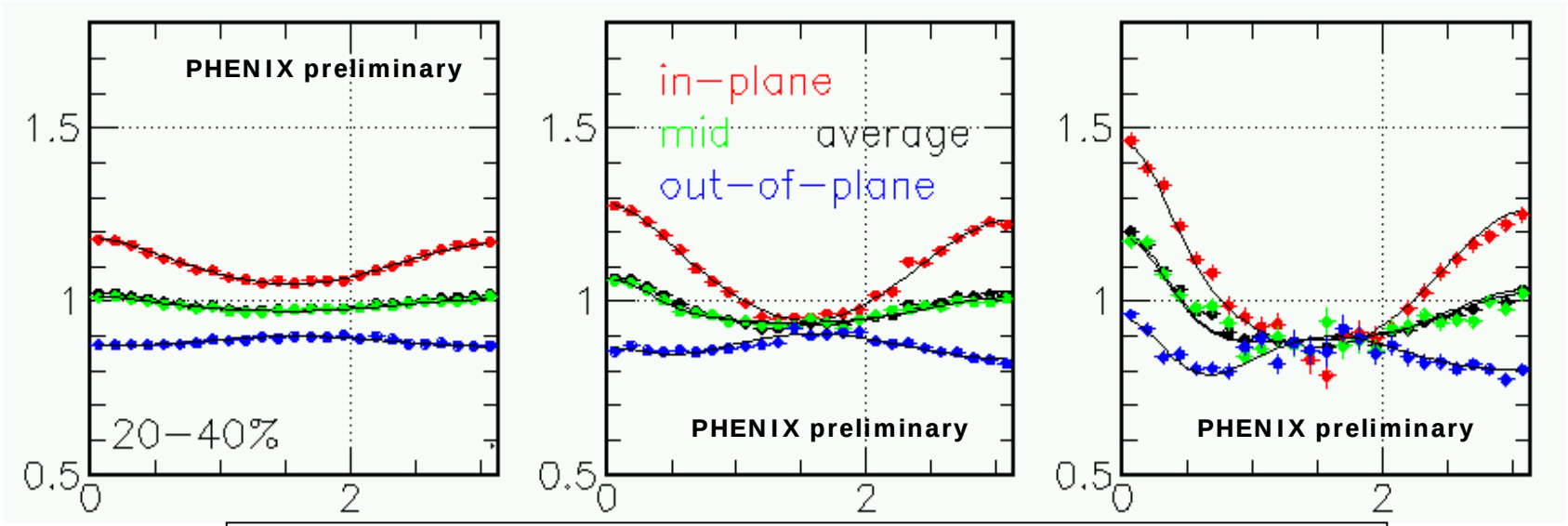


Au+Au 200GeV PHENIX preliminary


flow+jets
flow only (wrong!)
flow + flow&jets cross term
$V_2^{jet}=0$: reduce v2 just as BG
$V_2^{jet}>0$: almost no change or increase in v2
jets only
$\phi_{track1} - \phi_{track2}$
in-plane pair
in between
out-of-plane pair
trigger particle in the selected angular window
r.p.
$|\phi_{track1} - \phi_{track2}|$

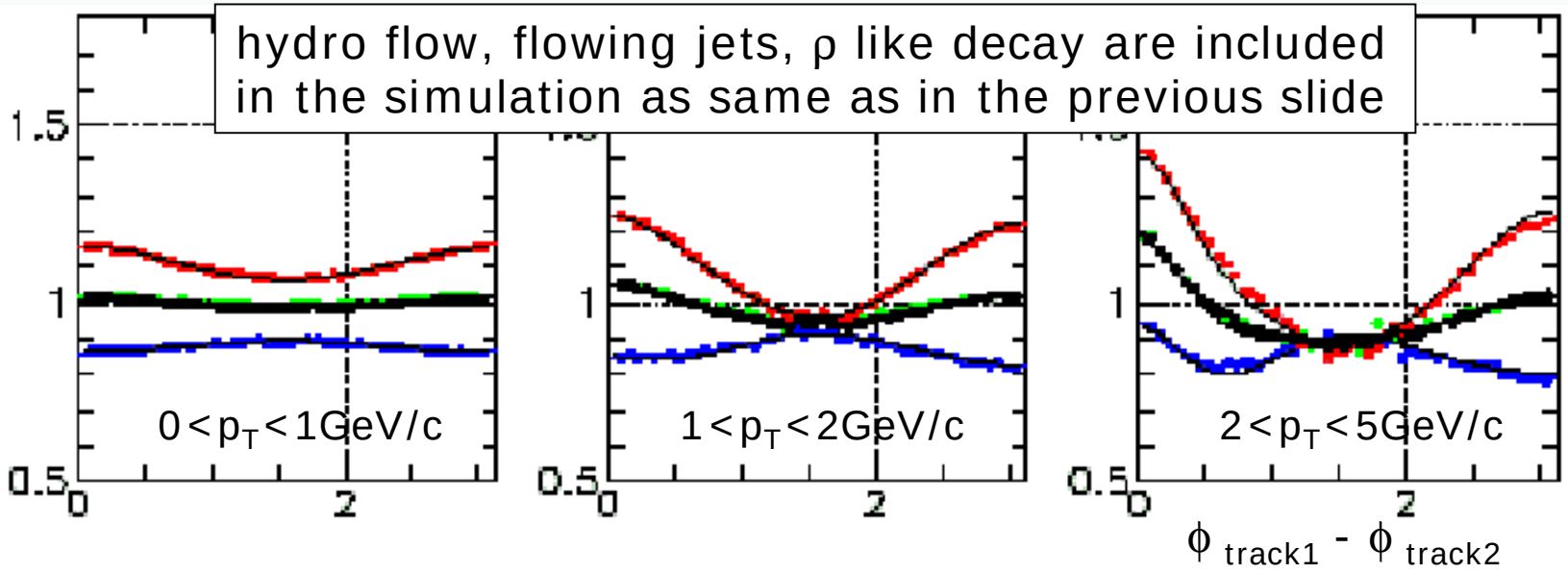
hadron-hadron correlation (p_T(trig)>3GeV/c)

Au+Au 200GeV data



simulation

hydro flow, flowing jets, ρ like decay are included in the simulation as same as in the previous slide



DNP03 / Fall

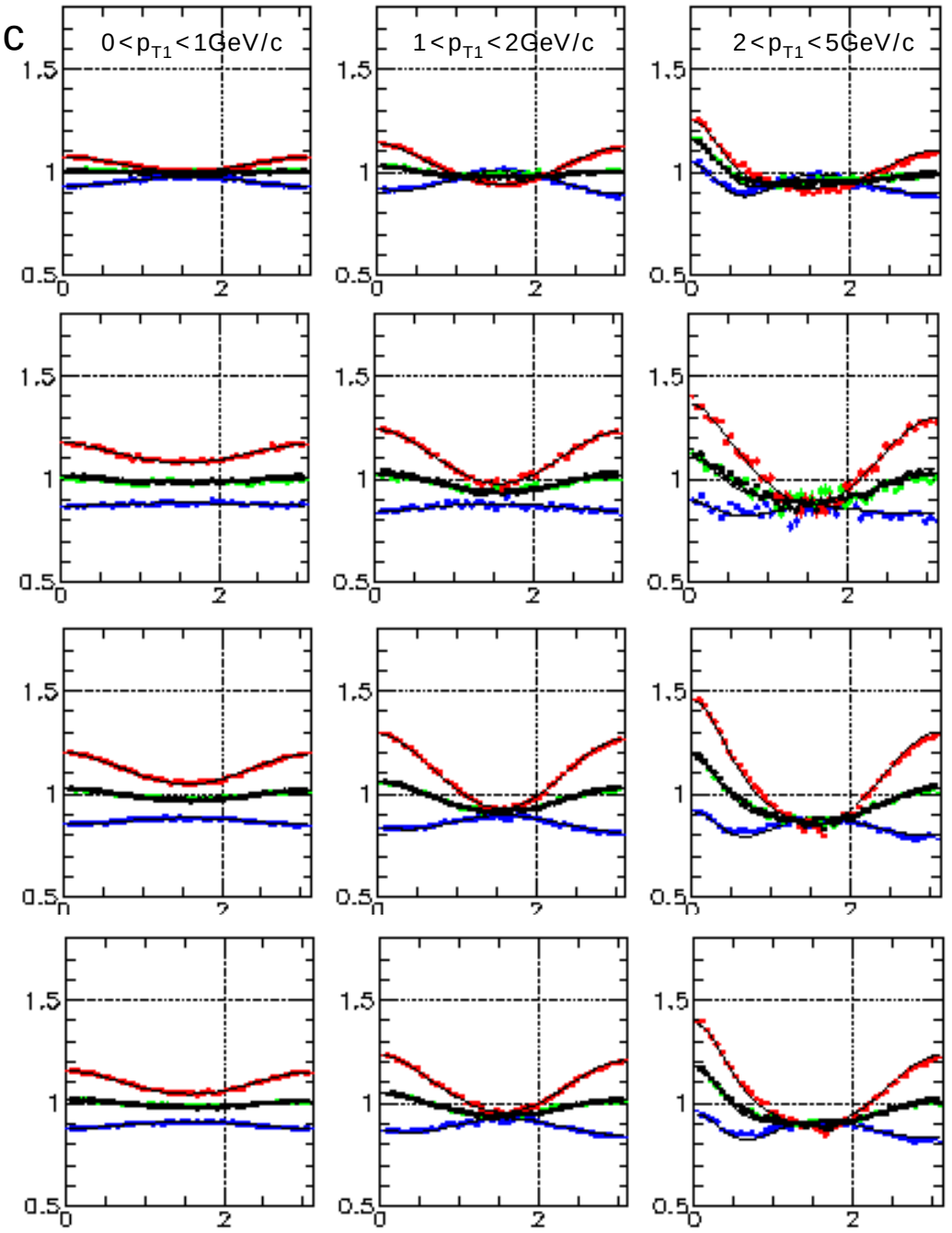
$p_T(\text{trig}) > 3\text{GeV/c}$

No flowing jets

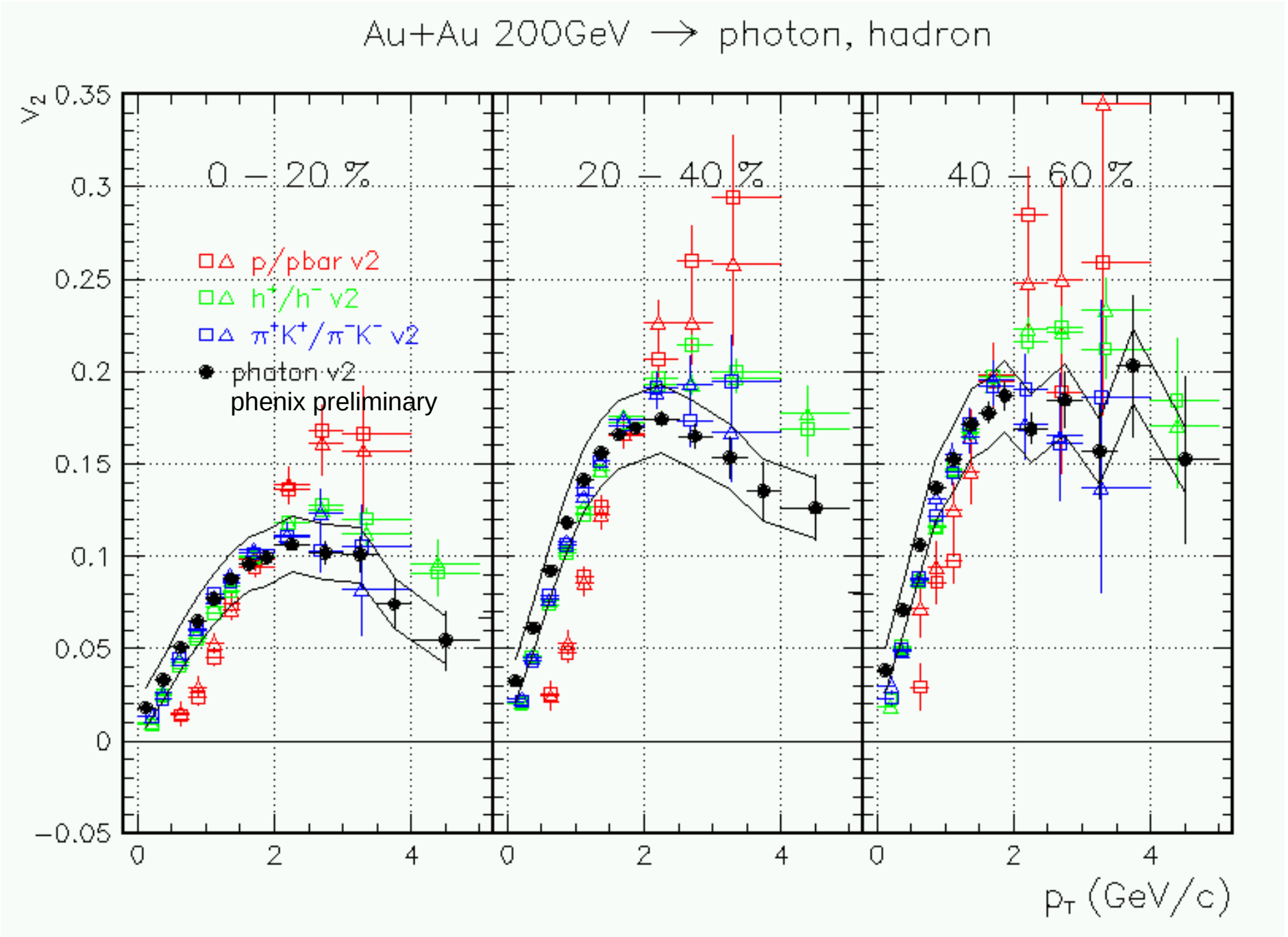
No flowing jets, reduced jets yield

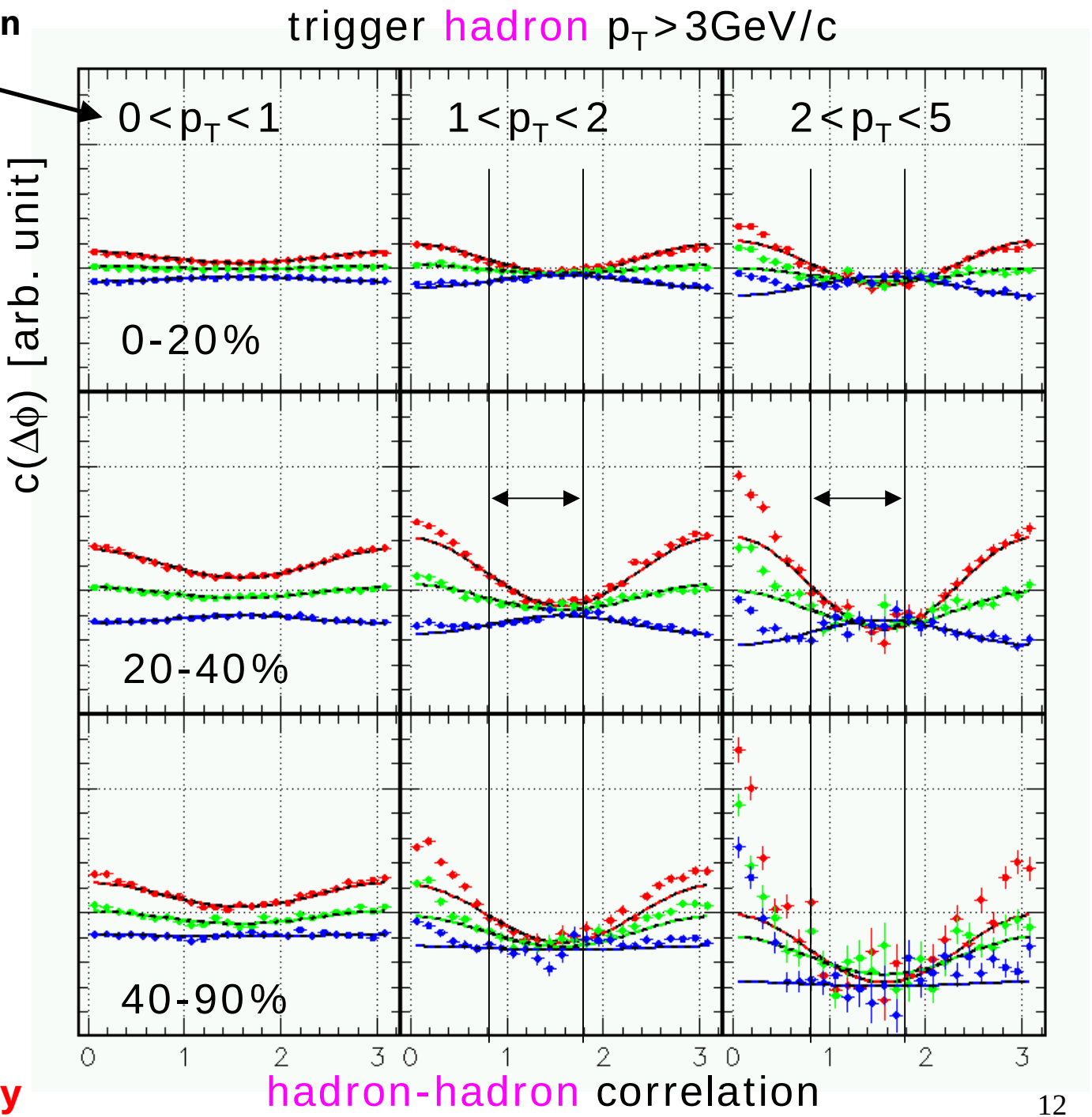
No ρ like decay

No ρ like decay, reduced v_2



simulation


Au+Au 200GeV → photon, hadron
v_2
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
−0.05
0 − 20 %
20 − 40 %
40 − 60 %
p/pbar v2
h⁺/h⁻ v2
π⁺K⁺/π⁻K⁻ v2
photon v2
phenix preliminary
0
2
4
p_T (GeV/c)

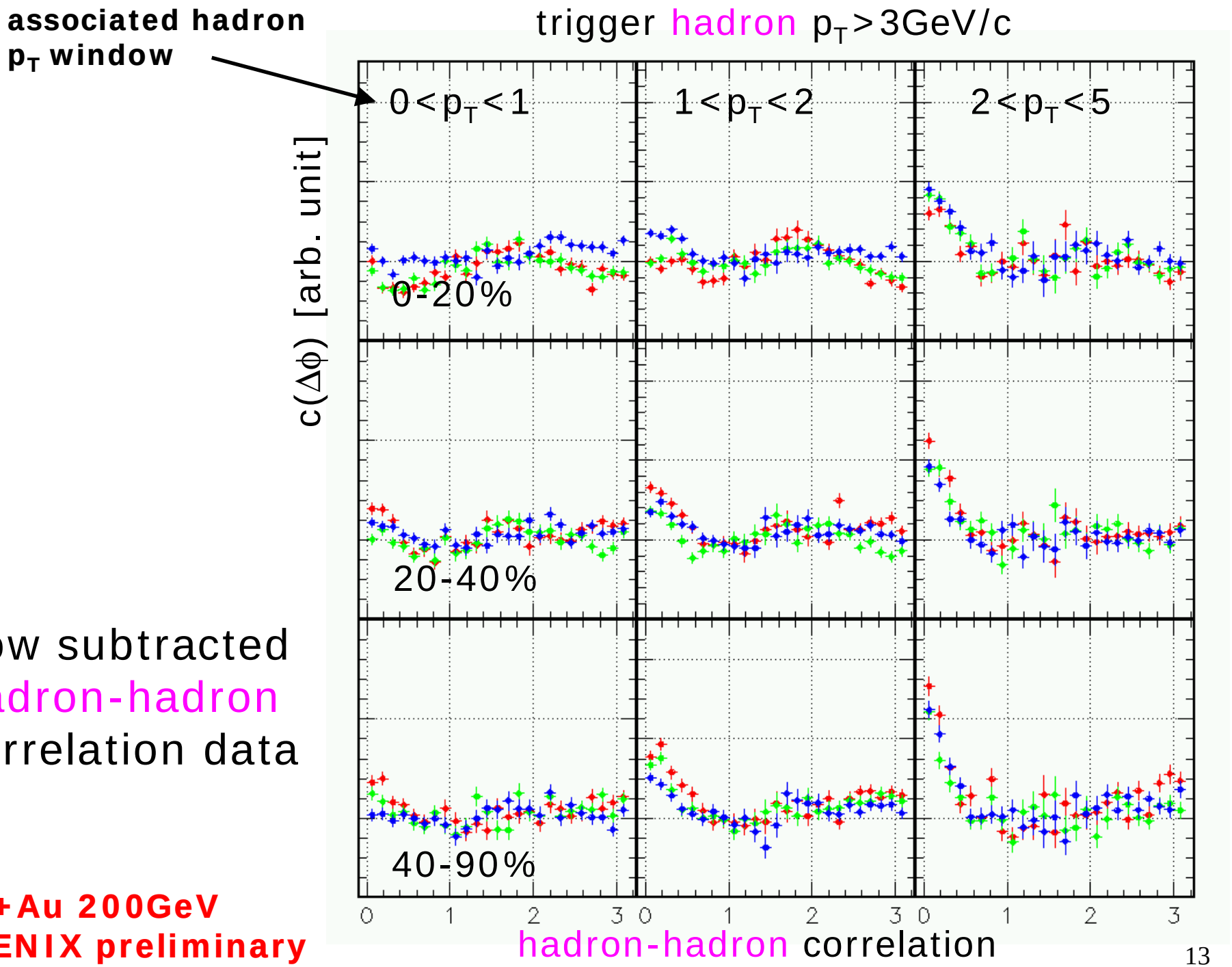


Fitted line shape is given by :

with fixed
(1)v_2(trigger)
(2)v_2(associated)
(3)R.P. resolution
(4)in/out bin width
(nucl-ex/0311007)

and one free normalization parameter fit is done in a limited range shown

Au+Au 200GeV
PHENIX preliminary


associated hadron p_T window
trigger hadron p_T>3GeV/c
$0<p_T<1$
$1<p_T<2$
$2<p_T<5$
0-20%
20-40%
40-90%
c(Δφ) [arb. unit]
hadron-hadron correlation
flow subtracted
hadron-hadron
correlation data
Au+Au 200GeV
PHENIX preliminary

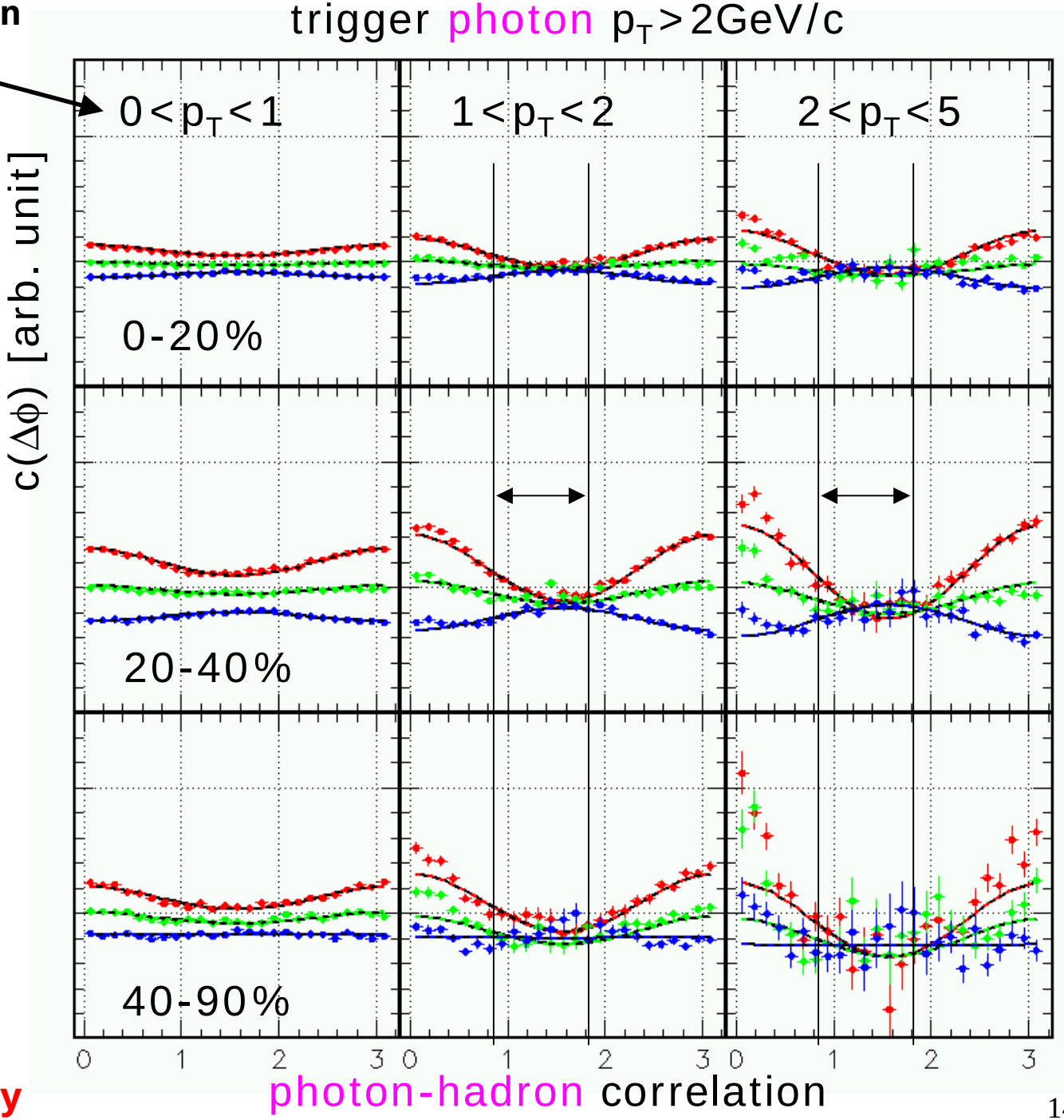
associated hadron p_T window

in-plane
middle
out-of-plane

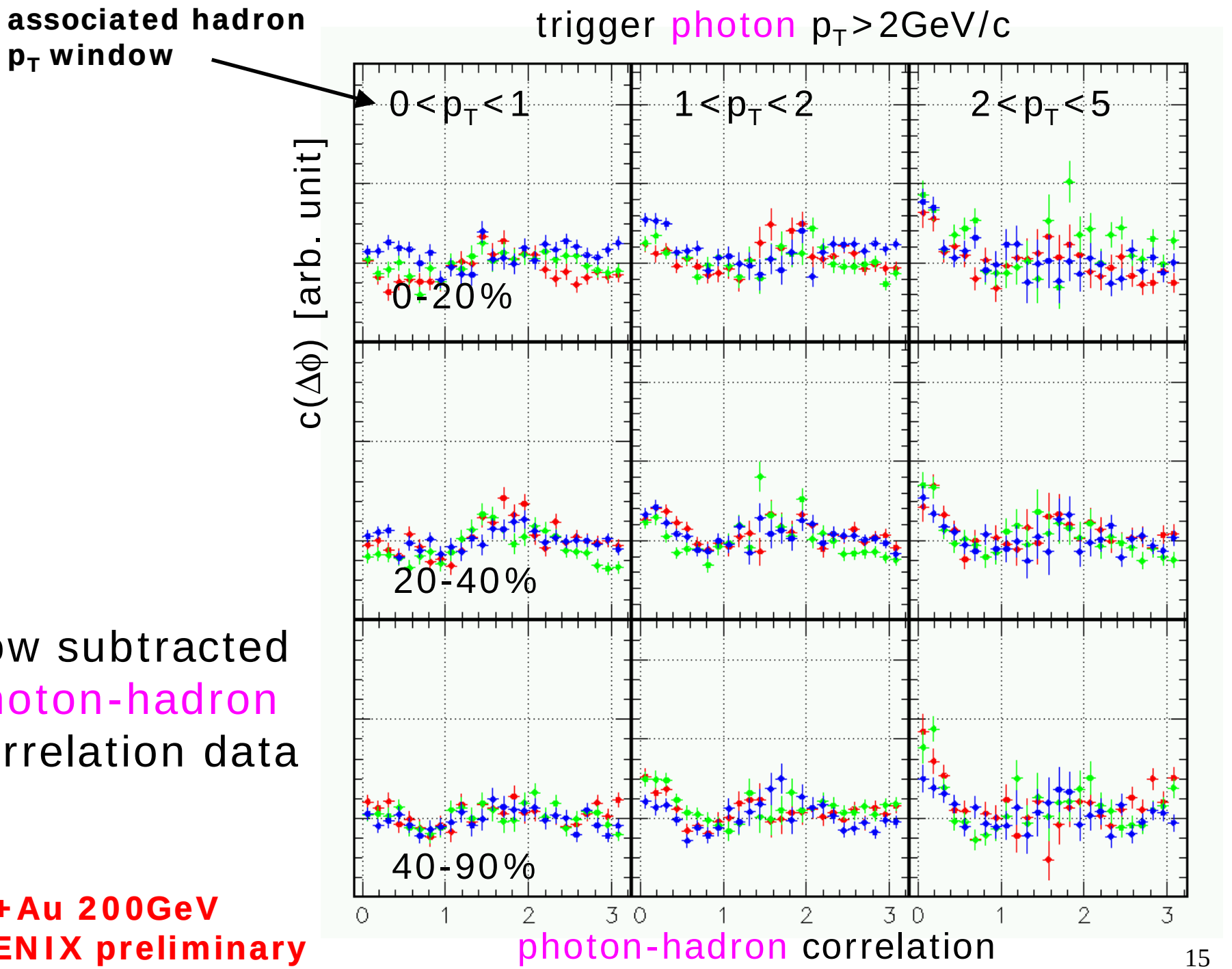
Fitted line shape is given by :

with fixed
(1)v_2(trigger)
(2)v_2(associated)
(3)R.P. resolution
(4)in/out bin width
(nucl-ex/0311007)

and one free normalization parameter fit is done in a limited range shown



Au+Au 200GeV
PHENIX preliminary



flow subtracted photon-hadron correlation data

Au+Au 200GeV
PHENIX preliminary

Summary

(1) very pronounced near side jets
(2) very broad far side jets seem to exist, that are not much different from far side v_2 shape
(3) Jets seem to be flowing (have v_2)
(4) different sensitivity to non-flow in different types of analysis

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